

February 5, 2008

MEMORANDUM

TO: Richard Huddleston, P.E.
Wastewater Program, DEQ State Office

FROM: John Tindall, P.E.

SUBJECT: **Staff Analysis, Granite Reeder Water and Sewer District, Wastewater Land Application Permit, LA-000219-01 (Municipal Wastewater)**

Purpose:

The purpose of this memorandum is to satisfy the requirements of IDAPA 58.01.17.400.04 (Wastewater Reuse Rules) for issuing wastewater reuse permits. The principal facts considered in preparing the draft permit conditions are presented with a summary of the basis for the draft conditions.

Process and Site Description:

The Granite Reeder Water and Sewer District (District) encompasses a community at the northwest end of Lower Priest Lake. Wastewater is currently treated and disposed of through subsurface systems (mostly individual and some community systems). A centralized wastewater system is needed to eliminate many sub-standard systems throughout the District.

The system is not constructed and is scheduled to be operational in late 2008 or 2009. The majority of the collection system will consist of grinder pumps installed at each building with raw wastewater pumped through 1.5" to 6" diameter HDPE pipe to the proposed treatment site. There may be a few homes that will be served by gravity sewer and a common lift station. The treatment system and reuse site will be located on 60 acres with the following legal description: T. 61 N., R. 4 W., Section 17, E½NE¼, Boise Meridian, Bonner County, Idaho. The District is purchasing 80 acres from the Forest Service (the final sale has not been completed yet) but 20 acres is located across Reeder Bay Road and will not be part of the initial wastewater treatment system. Figures 1 and 2 show the site. The treatment system will consist of two (2) aerated lagoons each 2.3 acres and a total volume of about 16 million gallons that will provide wastewater treatment as well as non-growing season storage (October through April). The lagoon will be sized for a build-out population of 800 ERs while the initial irrigation site will be sized for 600 ERs. The population at start-up is estimated to be 360 ERs. The useable area of the irrigation site (less the buffers and areas not to be irrigated) will be 49 acres. The irrigated crop will be a mix of deciduous and conifer trees. A buried irrigation system with risers for the spray nozzles will be installed. Chlorine disinfection will occur prior to irrigation.

Figures 1 and 2 (on pgs. 9 and 10) show the site lay-out and the homes near the site.

Summary of Events:

The District has been attempting to construct a centralized wastewater system since the 1980s. A facility plan titled "Wastewater Facilities Plan for the Granite/Reeder Sanitary Sewer System, June 2002" prepared by Welch Comer & Associates and the "Facilities Planning Document Addendum, June 2003" provided the basis for the selection of the lagoon treatment/seasonal irrigation as the preferred alternative. DEQ approved the facility plan July 10, 2003. The proposed system will be

similar to other systems being successfully operated in the Priest Lake area (Kalispel Bay, Outlet Bay, Coolin, Huckleberry Bay) serving a mix of full-time residents and many seasonal residents.

The District submitted a wastewater reuse application and the supporting documentation on July 31, 2007. The application was determined to be complete by DEQ and a letter dated August 31, 2007 was sent to the chairman, Vince Aguirre, acknowledging this determination.

In June 2007, Bonner County approved the Conditional Use Permit for constructing the treatment/reuse system on the proposed 60 acre site.

Discussion:

Relevant issues concerning site conditions, data, and historical and proposed management for purposes of determining permit conditions.

- **General Site Characterization:** The proposed 49 acre land application site contains a variety of trees as identified in the Silviculture Plan prepared by Hansen Timber Management, April 2, 2007. The conifer tree species include Western Hemlock, Western Red Cedar, Grand Fir, Western White Pine, Western Larch, Lodgepole Pine and Douglas Fir. The deciduous tree species include alder and black cottonwood. Portions of the site have been logged over the past 15-20 years. The regrowth is good in some areas and the trees are in a stage of growth when hydraulic/nutrient uptake rates are high. Areas in the eastern part of the site will need to be thinned and replanted to optimize the crop for utilizing the irrigated wastewater.
- **Soils and Topography:** Soils on the site are predominately sandy loam as determined from five (5) test pits. Topsoil varies from 0.5' to 1.5' deep. Depth to bedrock was greater than 5' in all the test pits. Permeability varies from 5.0 in./hr. to 1.6 in./hr. Elevations vary from 2520' to 2475' on the site. The highest elevation area will not be irrigated because it has excessive slope and close to an existing domestic well. In general, the slopes are gentle.
- **Ground Water:** A hydrogeological evaluation of the ground water under the site has been prepared by Strata, Inc. dated May 2007 (included in the Reuse Application). As part of that evaluation, three (3) monitoring wells were installed in 2007. Based on the evaluation, the following conclusions were reached:
 - There is an unconfined aquifer beneath the site.
 - Ground water flow is generally to the east (varying from 93.6° as measured in March 2007, 97° as measured in August 2007 and 86° as measured in September 2007).
 - High hydraulic conductivity.
 - Steep gradients
 - Depth to ground water below the ground surface based on limited monitoring well data appears to vary between 15'-30'.
 - It has been agreed that a fourth monitoring well will be drilled in 2008 along the west boundary of the site. This fourth well will provide a true upgradient well based on the ground water flow direction determined from the three original wells.

Ground water is used by the residents immediately to the south of the site for drinking water. There is concern about impacting their water supplies and Granite Creek. The nearest domestic well to the proposed site is owned by Mayer and is about 276' from the south boundary as shown on Figure 2. Granite Creek is 346' to the south at the closest point to the site.

As shown in Fig. 2, the proposed site boundaries are closer than 500' from some of the domestic wells. DEQ has considered a minimum buffer distance of 500' from domestic wells necessary for public health protection in the absence of detailed hydrogeological data on a proposed site. The hydrogeological evaluation has demonstrated that flow is generally to the east and away from wells that are within 500'. The District also owns the 20 acres to the east of the proposed site (across from Reeder Bay Road). By controlling this land parcel along with the not using the southeast corner of the site for irrigation (see Fig. 2) and the determination that ground water flow direction is generally to the east, ground water will travel more than 500' of any area that is irrigated before encountering a domestic well.

- **Surface Water Considerations:** The nearest surface water is Granite Creek to the south of the proposed site (see Fig. 2). At the closest point, the creek is 346' from the proposed site. Priest Lake is 1,994' from the proposed site.
- **Proposed Site Loading and Related Permit Recommendations:**
The total site is 60 acres including the two lagoons and proposed 50' buffers around the site. The proposed irrigated area is 49.1 acres. The existing mix of deciduous and conifer trees will provide the crop to be irrigated.

Hydraulic Loading Rates: Application on the site is proposed between May 1 to September 30 each year.

The following table shows the maximum allowable hydraulic loading rates:

Table 1
Maximum Allowable Hydraulic Loading Rates for Site

Land Application Area (acres)	Net Irrigation Requirement ¹ (IR) (inches)	% of IR Allowed Due to Slope Limits ²	Irrigation Efficiency ³	Adjusted Irrigation Requirement (inches) ⁴	Volume of Irrigation Water Required (ft ³) ⁵	Volume of Irrigation Water Required (gallons) ⁶
49	2.04- May	100%	80%	2.55	453,569	3,392,696
49	3.57 - June	100%	80%	4.46	793,300	5,933,884
49	6.76- July	100%	80%	8.45	1,503,002	11,242,455
49	4.90- August	100%	80%	6.13	1,090,343	8,155,766
49	2.72- Sept.	100%	80%	3.40	604,758	4,523,590
TOTALS	19.99			24.99	4,444,972	33,248,391

Notes:

1. From Kimberly/Univ. of Idaho website (Sandpoint Exp. Station, orchard crop) using the Allen and Brockway method. An "orchard crop" is the closest match to the forested site.
2. Irrigation on the slopes greater than 10% will need to be monitored for run-off.
3. The irrigation system consists of a solid set, above-ground sprinkler system. In Table 4-12, Ch. 4.4.8 of the DEQ publication, "Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater - September 2007", the range of irrigation efficiencies is 60-85%. 80% would a reasonable value.
4. $IR * (\% \text{ of IR Allowed}) / \text{Irrigation Efficiency}$
5. $\text{Area} * 43,560 * \text{Adjusted IR} / 12$
6. $\text{Volume of irrigation water required} * 7.48$

The estimated year 2013 wastewater to be irrigated is 18.8 million gallons (MG). In preparing the water balance with these projected flows, the consultant used average monthly effective precipitation. Design of the storage volumes required and estimated land application rates using this assumption appear to be reasonable because there also is a 30% safety factor included in the calculation of the estimated wastewater flows. The projected 20-year population of 600 ERs will require 40.62 acres for irrigation (a total of 27.6 MG to be irrigated) using the assumptions included in the water balance. The lagoons will be sized for 800 ERs and the land application area is 49 acres. There will be adequate time for the District to evaluate the accuracy of these assumptions and make adjustments in the coming years to assure there is adequate capacity.

As shown in Table 1, the total hydraulic loading theoretically required by the 49 acres of trees is 33.2 MG during the application season.

Nitrogen and Phosphorous Loading:

Table 2
Maximum Allowable Nutrient Loading Rates

Total Nitrogen Uptake¹ (pounds per acre, annual average)	Annual Total Nitrogen Permit Limit at 150% of uptake² (pounds per acre)	Phosphorous Uptake³ (pounds per acre, annual average)	Annual Phosphorous Permit Limit at 100% of uptake³ (pounds per acre)
150	225	20	20

Notes:

1. From Ch. 7.7.9.1 and Table 7-30 of the DEQ, "Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater – September 2007" the range for trees is 80-220 lb./ac./yr. To be conservative, the lower limit of the range was selected.
2. Calculation from Ch. 4.4.16 of the DEQ, "Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater – September 2007". Even though the wastewater application period is only between May to September, the total annual value has been used because the nutrients would remain in the soil and uptake would continue after the applications stopped.
3. From Ch. 4.4.20 in the DEQ, "Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater – September 2007" and DEQ guidance titled "WLAP Permit Nutrient Limits, How to Determine Compliance".

COD Loading:

The COD applied to the site will be estimated at 50 mg/l. This value is not expected to change over the 5-year period covered by the new permit. The loading limit of 50 lb./ac./day is from Ch. 4.2.2 of the DEQ, "Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater - September 2007".

Loading Summary:

Table 3 compares loading limitations to estimated loadings at the end of the 5-year permit period:

Table 3
Loading Comparison

Parameter	Limitation (using 49 acres)	Estimated (in 2013)	Comments
Maximum Monthly Hydraulic Loading	May –3,392,696 gals. June –5,933,884 gals. July –11,242,455gals. Aug. –8,155,766gals. Sept.– 4,523,590 gals.	May – 1,924,000 gals. June – 3,367,000 gals. July –6,378,000gals. Aug. – 4,627,000gals. Sept.– 2,566,000 gals.	Based on 80% irrigation efficiency.
Chemical Oxygen Demand (COD)	50 pounds/acre-day based on a yearly average ¹	1.0 pounds/acre-day based on a yearly average	Based on 50 mg/L COD, 18.9 MG over the 153 day season and 49 acre application site
Nitrogen	225 pounds/acre-year ²	129 pounds/acre-year	Based on 40 mg/L TN and 18.9 MG/yr. (6,305 lbs. of TN) and 49 acre application site
Phosphorous	20 pounds/acre-year ²	16 pounds/acre-year	Assume 5 mg/l TP, 18.9 MG/yr. and 49 acre application site.

Notes:

1. COD limit from Ch. 4.2.2 of the DEQ, "Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater - September 2007".
2. Refer to Table 2 above for limits

- **Soil Considerations:** The new permit will have some soil monitoring requirements to conform with the current standard permit conditions.
- **Buffer Zones:** Table 6.4 in Section 6.5.2 of the DEQ, "Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater – September 2007" sets forth the buffer zone requirements for municipal wastewater application sites. The site currently has the following characteristics:
 1. Degree of Treatment: Raw wastewater is treated through the aerated/storage lagoons previously described. The effluent is chlorinated prior to being irrigated and contact time is achieved through an oversized pipe connecting the lagoon discharge with the irrigation system. The proposed disinfection level is a total coliform limit of less than 23/100 ml. (Class C per Table 6.4).
 2. Location: Rural
 3. Mode of Irrigation: Buried laterals, above-ground irrigation with sprinklers.
 4. Buffer Zone: The nearest existing homes will be a 380' south of the southern site boundary (minimum recommended 300' for a "rural" setting). The closest existing public access (Reeder Bay Road) is approximately 50 feet away along the eastern site boundary (minimum recommended 0' for a "rural" setting). There are private wells along the eastern site boundary that will be closer than the recommended buffer of 500' (see Section 6.5.1 of the DEQ,

"Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater – September 2007"). The hydrogeological evaluation previously referred to has shown that the ground water flow direction under the site is to the east and away from these wells. No private wells down gradient from the site are closer than 500'. In addition, the lagoons are positioned within the site so they are the minimum 200' from the nearest property line per the "Wastewater Rules" (IDAPA 58.01.16.493.05).

5. Fencing: Table 6.4 recommends that for the proposed disinfection level of 23 cfu/100 ml. total coliform, a minimum 3-wire pasture fence should be installed around the perimeter. The USFS has requested that no fencing be installed to allow for animal movement through the site. There will be a forested 50' buffer around the entire site. As a substitute for the fencing, warning signs will be posted at 100' intervals around the north and west sides and every 50' on the south and east sides. All corners will also be posted.
6. Posting: As discussed in item #5 above, the site will be posted with signs reading "Irrigated with Reclaimed Wastewater - Do Not Drink" or equivalent.

As proposed, the application site will be in compliance with buffer zone requirements and the disinfection system will be capable of meeting the disinfection limit of 23/100 ml. total coliform.

- **Solids Management:** The treatment/storage lagoons may not need to have sludge removed for 20 years based on the sludge accumulation that has been observed in similar systems.
- **Lagoon Leakage Testing:** The lagoons will be leak tested as part of the construction of the lagoons which should occur in 2008-2009. The leakage test may have to be done in 2010 so that the lagoons can be tested under full volume conditions. Prior to the permit renewal, the lagoons should again be leak tested.

RECOMMENDATIONS

A. Proposed "Operating Requirements" in new permit:

1. Hydraulic loading of the irrigation site will be the limiting factor. The 49 acre site will be divided into 18 irrigation zones (hydraulic management units or HMUs). The maximum seasonal amount that can be applied on the 49 acres is 33 MG. During the first 5 years of operation, it is estimated that the maximum wastewater generated to be irrigated will be 18.9 MG. Monthly hydraulic loading limits for the site will be included in the permit based on this 5 year flow projection.
2. Limit the application period to May 1 to September 30.
3. The 18 zones are roughly the same acreage and are to be irrigated sequentially. The O&M Manual will need to include an irrigation schedule for the zones to assure that the maximum monthly hydraulic loading rates are not exceeded for any zone. Based on the estimated permeability rates of the soils (5.0-1.6 in./hr) and the relatively low loading rates (a maximum of about 0.5 in./day) and irrigation only during the growing season, ponding or surface run-off is not likely to occur. The design hydraulic loading rates are conservative enough that soil moisture probes will **not** need to be installed to determine if the site can receive any additional water without causing gravity drainage to allow water to migrate past the root zone. The monitoring wells will be used to evaluate impacts to ground water.
4. Total coliform limits will be the median value of the last five (5) results must not exceed 23/100 ml. (Class C criteria per Table 6.4). In addition, no single sample value shall exceed 240/100 ml. Disinfection and compliance occurs at the end of the chlorine contact pipe and prior to entering the irrigation distribution system before the first sprinkler head.
5. Limit land application of COD to 50 pounds/acre-day. This formalizes a guideline that is a standard requirement in recent permits. The analysis indicates that the operation can conform

to this limitation. No testing for this parameter will be required because the anticipated loading is only 1.0 lbs./acre/day.

6. Limit nitrogen application to 150% of typical crop uptake in pounds/acre-season from wastewater and non-water sources. Recent permits impose nitrogen application limits to ensure groundwater protection. The analysis, based on minimum nitrogen requirements for trees, indicates that the operation should be able to conform to this limitation. The silviculture plan should make recommendations on the nitrogen requirements of the trees. The wastewater and soil will be monitored for nitrogen as part of the new permit.
7. The analysis indicates that the phosphorous applied in the wastewater will be less than the calculated demand of 100% of the typical tree uptake. The wastewater and soil will be monitored for phosphorous as part of the new permit. Soil results will be analyzed during the next permit issuance to determine if the recommended phosphorous guidance limits from Section 4.2.2.7 of the DEQ "Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater – September 2007" are met.

B. Proposed "Monitoring Requirements" in new permit:

1. Wastewater:

- Total influent flow to lagoons – Daily and monthly.
- Total chlorine residual concentration – Any day irrigation occurs from the sampling port at the downstream end of the chlorine contact chamber.
- Total Coliform – Weekly samples should be taken during the irrigation season. Samples to be collected from the sampling port at the downstream end of the chlorine contact chamber.
- Total Kjeldahl nitrogen (TKN), nitrate+nitrite-nitrogen – Monthly from the sampling port at the downstream end of the chlorine contact chamber.
- TDS – Not required. Secondary domestic wastewater that will not have significant amounts of TDS.
- COD – Not required. Secondary domestic wastewater that will not have significant amounts of COD (see Table 3).
- pH – Not required because it is domestic wastewater.
- Total Phosphorous – Monthly from the sampling port at the downstream end of the chlorine contact chamber.

2. Irrigation Site Monitoring:

- Precipitation and temperature - Instruments shall be installed on the land application site to monitor precipitation and temperature and daily readings will be recorded during the application season.
- Irrigated area (acres)– daily notations of which HMUs were irrigated.
- Irrigation periods (hours)– daily and monthly recordings for each HMU irrigated.
- Hydraulic loading of irrigated areas (gallons (daily and monthly) and inches (monthly)) for each HMU.
- Total Nitrogen loading (lbs/acre) – annually.
- Total Phosphorous (lbs/acre) – annually.
- Soil Monitoring - In accordance with current standard permit monitoring requirements, soil monitoring will be required. Sample from 3 depths (0-12", 12"-24" and 24"-36") and 10 subsamples taken across the 27.5 acre site. Each depth is composited and three samples are obtained for analysis. Sampling required in the first and fifth year of the permit. Sample once in April or May prior to starting land application for the season again in October after land application is finished. Sample for electrical conductivity, nitrate-N, ammonium-N, pH and plant available phosphorous.

3. Ground Water Monitoring:

- Ground water monitoring is proposed. There are currently three (3) monitoring wells drilled on the north, east and south site borders. A fourth well will be drilled on the west

site border in the summer 2008 to provide an upgradient well. The other three (3) wells will provide down gradient monitoring wells. Based on the estimated ground water flow direction, the east and south wells will provide the best down gradient information. The relatively close proximity of the site to private wells warrants monitoring of the wells for a number of parameters, as follows: field parameters (pH, temperature, electrical conductivity, and dissolved oxygen); static water levels; nitrate-nitrite as nitrogen; and chlorides. The monitoring frequency should be in May prior to starting irrigation and in mid-September prior to the end of the application season.

4. Lagoon Leakage:

- The lagoons will be leak tested in accordance with the latest DEQ procedure as part of the construction of the lagoons (probably completed in 2010).
- Perform a leakage test in accordance with the latest DEQ procedure on the lagoons one year before the permit expiration. Submit the results with annual report and in the permit renewal application.

REFERENCES

Allen, R.G. and Brockway, C.E., "Estimating Consumptive Irrigation Requirements for Crops in Idaho", University of Idaho, August 1983.

Idaho Department of Environmental Quality, "Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater - September 2007".

Kimberly University of Idaho Evapo/Transpiration Rates, Bayview Station found at the following website- <http://www.kimberly.uidaho.edu/water/appndxet/index.shtml> .

"Reuse Permit Application, Technical Report, Wastewater Treatment Facility, Granite Reeder Water and Sewer District, July 2007", prepared by Welch Comer & Assoc.

